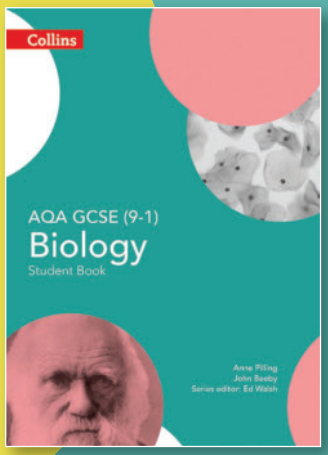
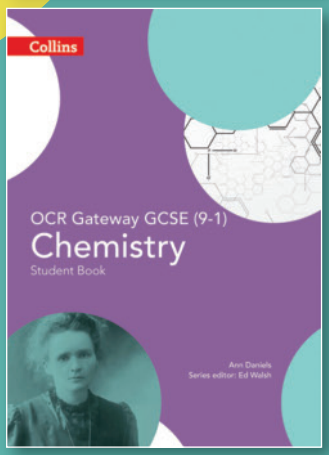
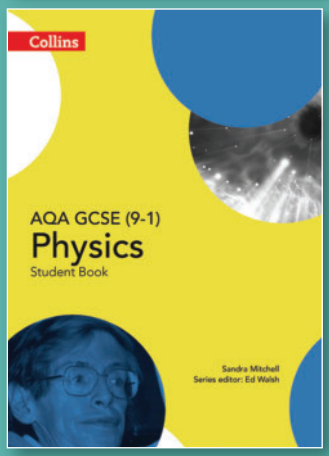
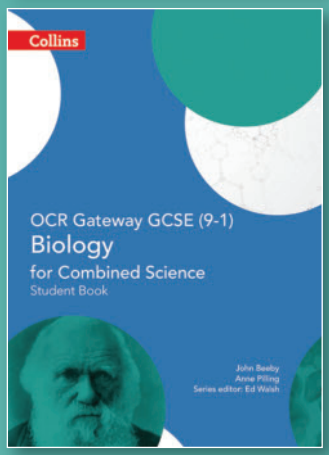
Collins









Available from
January 2016

GCSE Science

Engaging new resources for both the AQA and OCR Gateway GCSE (9-1) Science specifications.

Every student will need support in making good progress and to succeed in the new linear Science GCSEs.

With regular reviews and assessment that address performance as well as skills and understanding, our resources provide exactly that, for students at every level.

And we've done it in the most easily accessible way.

Our Student Books are in the AQA approval process and will be submitted to the OCR endorsement process.

Series Editor: Ed Walsh

Authors: John Beeby
Ann Daniels
Sandra Mitchell
Anne Pilling

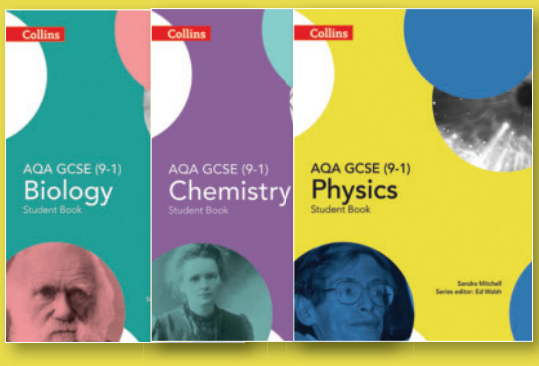
www.collins.co.uk/GCSEscience

GCSE Science

GCSE Science is changing, and our new resources for AQA and OCR Gateway will develop and embed the skills your students need to succeed in all three assessment objectives, while providing a clear and supportive route through the new, more challenging GCSE content.

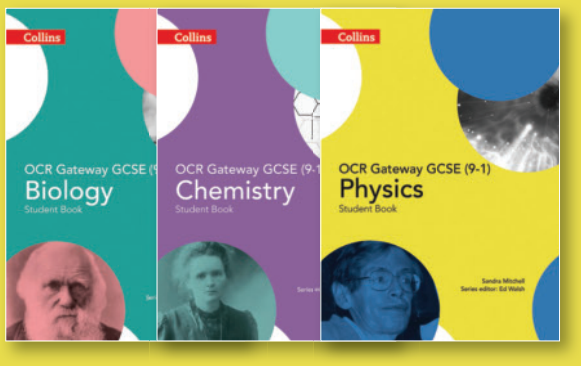
- **Teach with confidence** – our AQA Student Books, have been accepted for the **AQA approval process and the OCR Gateway Student Books** will be submitted to the **OCR endorsement process**
- **Fully flexible support in print and digital formats** – our course structure allows you to teach your way. With 2, 3 and 5 year schemes of work allowing easy progression from KS3 and a strong basis for A level sciences, plus options for teaching foundation and higher, single sciences and combined
- **Cover the requirements of the new (9-1) specifications**– teaching and learning resources combined with regular assessment that enables progression for every student
- **Coverage of the new required practicals** – develop and test skills in analysing, interpreting and evaluating information and ideas so students are fully prepared for the indirect assessment
- **Build maths skills** – a dedicated maths spread in every chapter and skills at the appropriate level embedded throughout, provide a wealth of support and practice

For AQA Single Science



AQA Combined Science: Trilogy and Combined Science: Synergy

For OCR Gateway Single Science



For OCR Gateway Combined Science

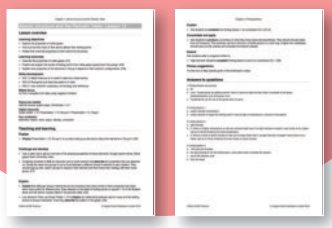
www.collins.co.uk/GCSEscience

How is Collins GCSE (9-1) Science structured?

Teach

Teacher Packs

Comprehensive support for delivering the new science GCSEs with detailed introductions to the new specifications, 2, 3 and 5 year schemes of work, and an editable bank of differentiated lesson plans and worksheets.



Assess

Ensure all students make good progress with our new, innovative assessment framework that uses regular checkpoints to help you analyse and track students' progress across the linear course. See page 5 for full details.

GCSE (9-1) Science

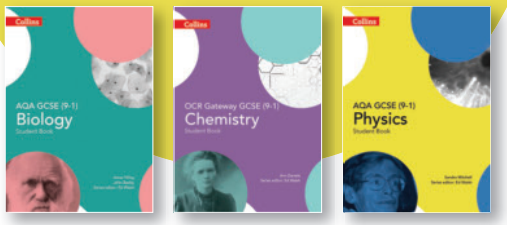
Collins Connect

Content is available online at home and at school, meaning it's ideal for use as a front-of-class teaching tool and as a way to set homework and tests. See page 9 for full details.

Learn

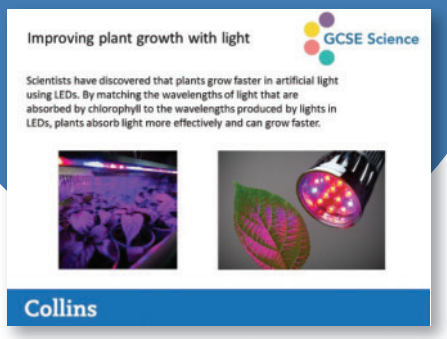
Student Books

Written by a team of expert authors for the new GCSE (9-1) specifications for AQA and OCR Gateway, the student books support students of all abilities with ramped content and questions on every page. Go to **collins.co.uk/GCSEscience** for full details of how the resources support progress for all of your students.



Build Skills

Worked examples and practice questions incorporated throughout the Student Books support the new maths and practical requirements. Go to **collins.co.uk/GCSEscience** for full details of support for maths and practicals.



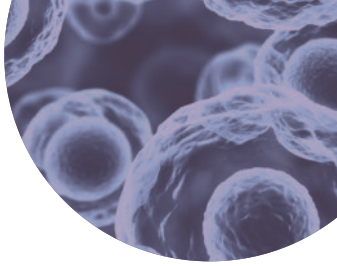
COLLINS ARE PUBLISHING FOR THE FOLLOWING SPECIFICATIONS:

AQA GCSE Science (9-1)
AQA Single Sciences (Biology 8461, Chemistry 8462, Physics 8463), AQA Combined Science: Trilogy (8464) and AQA Combined Science: Synergy (8465)

OCR Gateway GCSE Science (9-1)
OCR Gateway Single Science (Biology A (9-1) J247, Chemistry A (9-1) J248, Physics A (9-1) J249) and OCR Gateway Combined Science (Combined Science A (9-1) J250)

The resources cover both Higher and Foundation tiers for all specifications.

Teaching the new Science GCSEs



Key changes to the new Science GCSEs	How our resources support you
Practical assessment ● Controlled assessment is being discontinued and at least 15% of the total marks available for each GCSE will be dedicated to practical skills	● Build and test the skills students need for the new practical assessment ● Full support for practical work, including lesson plans, worksheets and technician notes, in the Teacher Packs ● Resources for each required practical are available on Collins Connect to help students consolidate and practise their learning
An increased maths element ● Maths will account for 10-30% of assessment marks for single science (minimum of 10% in Biology, 20% Chemistry, 30% Physics) and 20% for combined (1:2:3 Biology, Chemistry, Physics). ● Foundation tier students must demonstrate maths skills at a minimum of KS3 Level and Higher tier students at a minimum of Foundation level GCSE Maths	● A Maths Skills spread in every chapter provides support for applying maths to science ● Maths skills are embedded throughout and tested at the appropriate level ● Maths activities on Collins Connect help students practise the skills they need for assessment
A linear course ● There are no modules, all assessment will take place at the end of Year 11	● Monitor assessment using regular assessment and common review checkpoints ● A bank of summative assessment materials and tracking tools in Collins Connect help you track performance across the course and target areas for improvement
New assessment objectives ● Assessment objective split: • AO1 (knowledge recall) – 40% • AO2 (application) – 40% • AO3 (analysis of information and ideas) – 20%	● Questions highlight which assessment objectives they are targeting ● Online digital testing on Collins Connect provides targeted feedback on student performance against each assessment objective
New exams and grading system ● 9–1 grading system for Single Science ● Combined Science will have a 17 point grading scale, from 9-9, 9-8 through to 2-1, 1-1	● Differentiated content throughout ● Colour coded indicator on each page shows the ramping of demand
More challenging content: ● The level of content has increased, as has the level of challenge	● Written for the 2016 specifications ● Written by a team of expert authors, the Student Books have entered AQA's approval process and will be submitted to OCR for endorsement

Track students' progress in the new linear GCSE course, with regular formative and summative assessment

Formative Assessment

When	Where	Impact
Ongoing informal and self assessment	● Integrated questions on every page and at the end of every chapter ● Digital, auto-marked homeworks for every lesson ● Detailed lesson plans with embedded opportunities to review students' performance	● Students can review how well they've understood a topic ● Helps check whether students have mastered the lesson content Next steps can be planned effectively

Ramped questions and outcomes embedded throughout

Summative Assessment

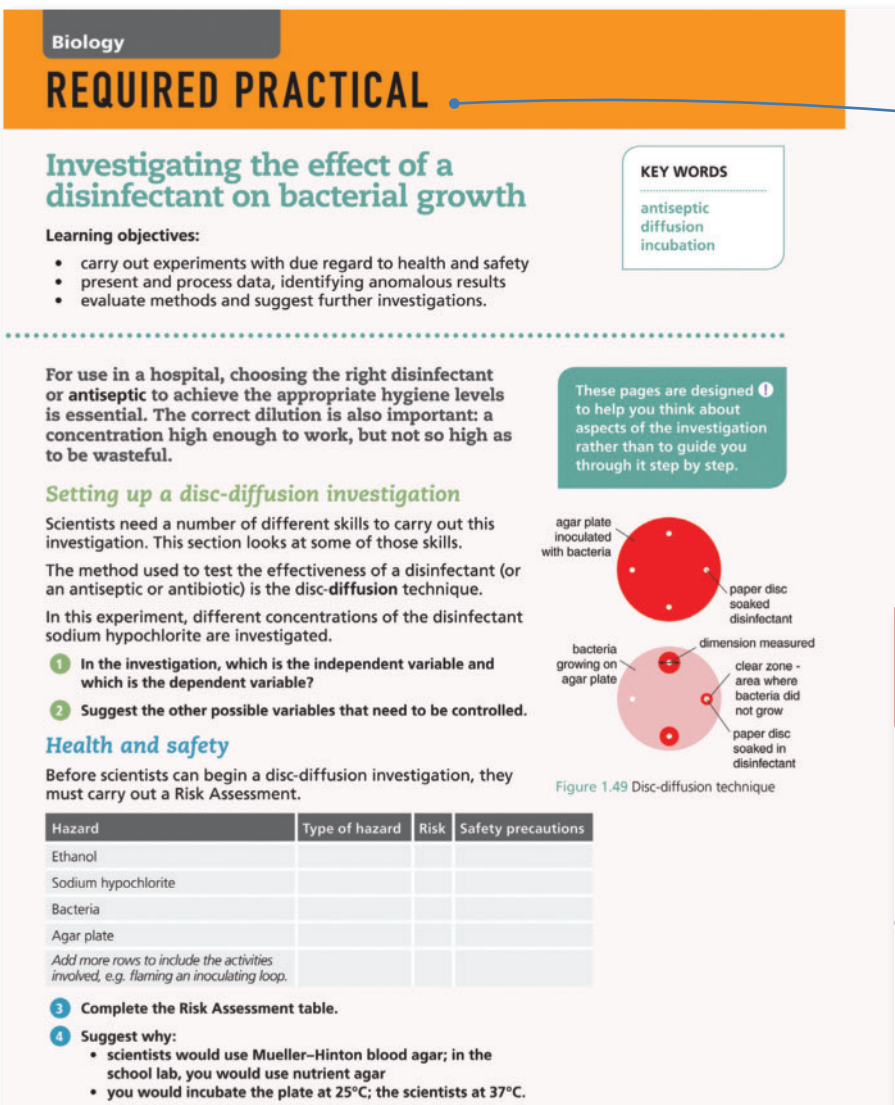
When	Where	Impact
End of topic	Print and digital tests: ● Print and digital tests track students' progress on a topic-by-topic basis	● Generate group and individual reports to analyse performance by: • Assessment objective (AO1, AO2, AO3) to see where strengths and weaknesses are • By skill to track performance in maths, required practicals and synoptic questions • By individual question type to scrutinise where errors were made ● Get targeted feedback for every student for every test so they know which areas to focus on.
End of teaching block	● Print and digital tests provide common review checkpoints throughout the linear course	
End of year and end of course	● Print tests help students prepare and practice for final assessment	

Regular assessment points to help you track and analyse student performance

Builds effectively on the Collins Science Key Stage 3 assessment framework to provide consistency in student data from age 11 to 16.

Student Books

- Accepted for the AQA approval process and will be submitted to OCR Gateway for endorsement.
- Written by a team of expert authors for the 2016 specifications
- Combine clear and comprehensive explanations with a wealth of practice opportunities, to help build the skills that students will need to succeed
- Dedicated pages for practical and maths skills ensure students are fully prepared for the new requirements
- Co-teach both Foundation and Higher tier with a single book
- Key concept spreads highlight concepts that students must grasp before they can move on



Biology

REQUIRED PRACTICAL

Investigating the effect of a disinfectant on bacterial growth

KEY WORDS
antiseptic
diffusion
incubation

Learning objectives:

- carry out experiments with due regard to health and safety
- present and process data, identifying anomalous results
- evaluate methods and suggest further investigations.

For use in a hospital, choosing the right disinfectant or antiseptic to achieve the appropriate hygiene levels is essential. The correct dilution is also important: a concentration high enough to work, but not so high as to be wasteful.

These pages are designed to help you think about aspects of the investigation rather than to guide you through it step by step.

Setting up a disc-diffusion investigation

Scientists need a number of different skills to carry out this investigation. This section looks at some of those skills.

The method used to test the effectiveness of a disinfectant (or an antiseptic or antibiotic) is the disc-**diffusion** technique.

In this experiment, different concentrations of the disinfectant sodium hypochlorite are investigated.

1. **In the investigation, which is the independent variable and which is the dependent variable?**
2. **Suggest the other possible variables that need to be controlled.**

Figure 1.49 Disc-diffusion technique

Health and safety

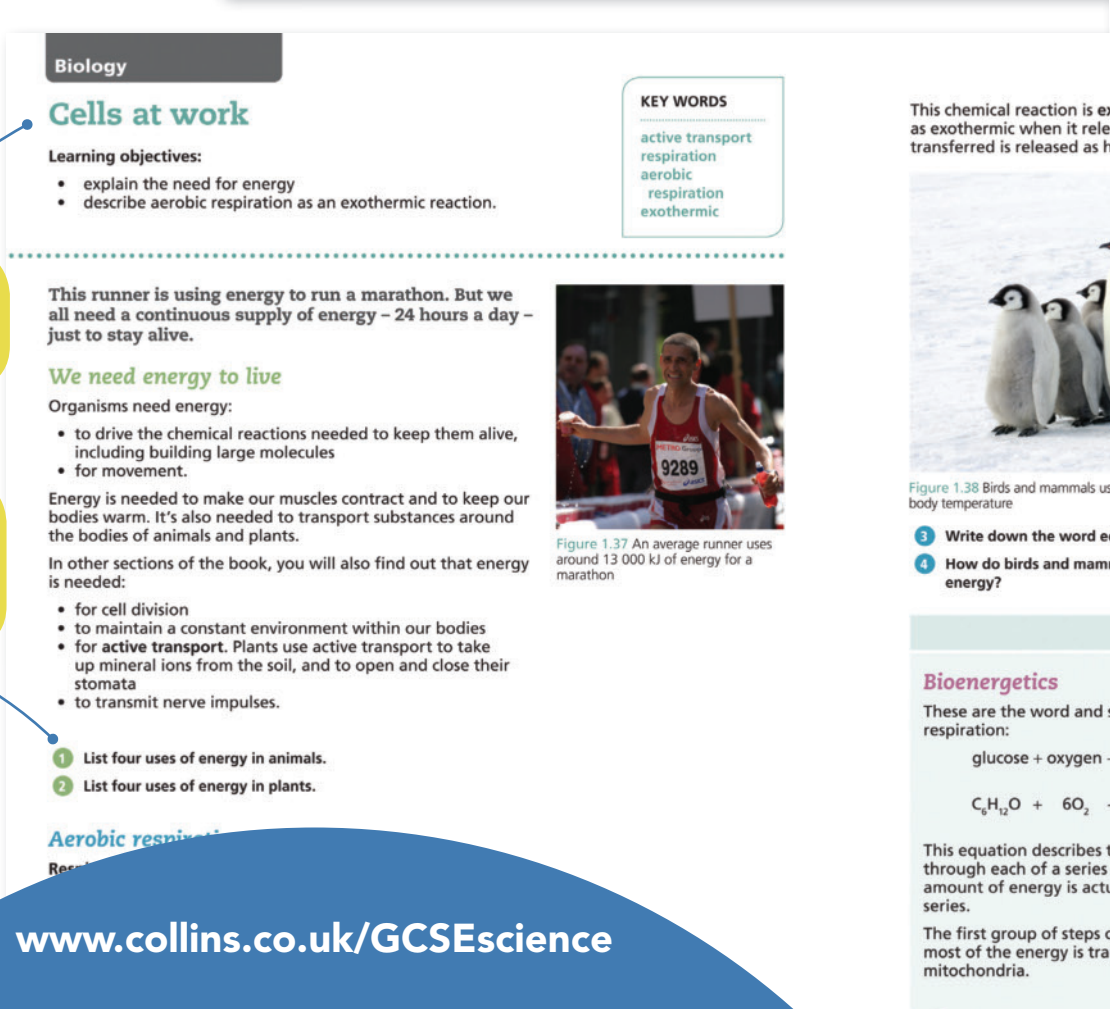
Before scientists can begin a disc-diffusion investigation, they must carry out a Risk Assessment.

Hazard	Type of hazard	Risk	Safety precautions
Ethanol			
Sodium hypochlorite			
Bacteria			
Agar plate			
Add more rows to include the activities involved, e.g. flaming an inoculating loop.			

3. **Complete the Risk Assessment table.**
4. **Suggest why:**
   - **scientists would use Mueller–Hinton blood agar; in the school lab, you would use nutrient agar**
   - **you would incubate the plate at 25°C; the scientists at 37°C.**

Each spread starts with language and ideas at a lower level and increases in complexity, engaging students of all ability levels

Prepare students for the demands of the new specification with differentiated questions, worked examples and lots of opportunities to practice



Biology

Cells at work

KEY WORDS
active transport
respiration
aerobic respiration
exothermic

Learning objectives:

- explain the need for energy
- describe aerobic respiration as an exothermic reaction.

This runner is using energy to run a marathon. But we all need a continuous supply of energy – 24 hours a day – just to stay alive.

We need energy to live

Organisms need energy:

- to drive the chemical reactions needed to keep them alive, including building large molecules
- for movement.

Energy is needed to make our muscles contract and to keep our bodies warm. It's also needed to transport substances around the bodies of animals and plants.

In other sections of the book, you will also find out that energy is needed:

- for cell division
- to maintain a constant environment within our bodies
- for **active transport**. Plants use active transport to take up mineral ions from the soil, and to open and close their stomata
- to transmit nerve impulses.

1. **List four uses of energy in animals.**
2. **List four uses of energy in plants.**

Figure 1.37 An average runner uses around 13 000 kJ of energy for a marathon

This chemical reaction is ex
as exothermic when it rele
transferred is released as h

Figure 1.38 Birds and mammals us
body temperature

3. **Write down the word e**
4. **How do birds and mam**
energy?

Bioenergetics

These are the word and s
respiration:

glucose + oxygen

$C_6H_{12}O + 6O_2$

This equation describes t
through each of a series
amount of energy is actu
series.

The first group of steps o
most of the energy is tra
mitochondria.

www.collins.co.uk/GCSEscience

REQUIRED PRACTICAL

Presenting and processing data

1.15

The agar plates are **incubated**, and the clear zones measured. Scientists need to analyse the data they have collected:

Concentration of sodium hypochlorite (g/dm³)	Area of clear zone around disc (mm²)			Mean area of clear zone around disc (mm²)
	Test 1	Test 2	Test 3	
0.0	0	0	0	0
0.5	0	0	0	0
1.0	32	31	34	32
1.5	91	89	91	90
2.0	470	381	379	380
2.5	499	505	497	
3.0	546	552	551	
3.5	575	568	567	
4.0	578	582	580	
4.5	580	580	580	
5.0	579	578	583	

5 **How is the area of a clear zone calculated? Hint: you need to recall a formula.**

6 **Complete the table by calculating the mean area of the clear zones.**

HINTS & TIPS

Required practicals spreads in each chapter build and test students' development of the appropriate skills

Maths skills are embedded throughout the book and revisited in dedicated maths pages

Biology

MATHS SKILLS

Size and number

Learning objectives:

- Make estimates of the results of simple calculations, without using a calculator.
- Be able to to use ratio and proportion to calibrate a microscope.
- Recognise and use numbers in decimal and standard form.

KEY WORDS

calibrate
graticule
haemocytometer
standard form

The size of structures is important in biology, from whole organisms to molecules.

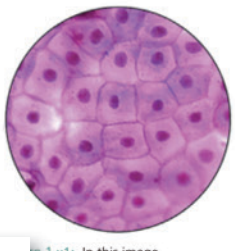
Estimating cell size

Accurate measurements are often essential. But estimating cell size or number is sometimes sufficient and may be quicker.

To estimate cell size, we can count the number of cells that fit across a microscope's field of view.

$$\text{Size of one cell} = \frac{\text{diameter of field of view}}{\text{number of cells that cross this diameter}}$$

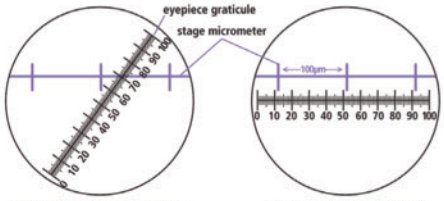
If the field of view of this microscope, at this magnification, is 0.3 mm, or 300 µm, we can do a quick calculation without



e 1.x1: In this image, *ximately* five cells fit across the of view. We round numbers down to make calculations htforward.

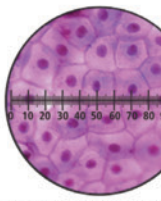
3 **What would be the diameter of a cell that was 65 divisions on this graticule?**

4 **How many graticule divisions would a cell that was 35 µm across take up?**



The graticule is enclosed within the eyepiece. A stage micrometer is placed on the stage of the microscope.

The divisions on the eyepiece graticule and stage micrometer are line up.



The calibrated eyepiece graticu be used to make measuremer any cells or other structures vi with that microscope.

Figure 1.x2: Calibrating, ther an eyepiece graticule.

Standard form of numbers

When writing and working with very large or very small numbers, it is convenient to use **standard form**. Standard form shows the magnitude of numbers as powers of ten.

Standard form numbers are written as: $A \times 10^n$

where: A is a number greater than 1 but less than 10
n is the index or power.

We use standard form with large numbers, small numbers and calculations.

In standard form:

- when multiplying: multiply numbers and add powers (see example in Figure 1.x3).
- when dividing: divide numbers and subtract powers.

Blood cell type	Width of an average cell in m
Lymphocyte (small)	7.5×10^{-6}
Macrophage	5.0×10^{-5}
Megakaryocyte	1.5×10^{-4}
Neutrophil	1.2×10^{-5}

The sizes of different types of blood cell, written in standard form.

5 **Look at the table of cell sizes. Arrange the cell types in descending order of size.**

6 **How many times larger is a megakaryocyte than a lymphocyte?**

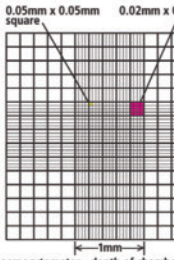


Figure 1.x3: Calculating the of a counting chamber. The co chamber is a hollow on a micr slide which holds a set volume fluid. It has a grid ruled onto it depth of 0.1 mm. The number in a given volume can be calcu

Google search: 'calibrating a microscope, haemocytometer, standard fo

1.11

xothermic. A reaction is described ases energy. Some of the energy eat.

e heat energy to maintain a constant

quation for aerobic respiration.

mals make use of the waste heat

HIGHER TIER

symbol equations for aerobic

→ carbon dioxide + water (energy released)

→ $6CO_2$ + H_2O (energy released)

he overall change brought about of chemical reactions. A small ually released at each stage in the

ccurs in the cytoplasm of cells, but nsferred by chemical reactions in

Figure 1.39 Insect flight muscles have huge numbers of well-developed mitochondria

DID YOU KNOW?

The muscle an insect uses to fly is the most active tissue found in nature.

HINTS & TIPS

Don't forget that *all* organisms respire. The equation is the reverse of photosynthesis, but

D YOU KNOW?

ientists *estimate* cell organism numbers hen it is impossible or necessary to count em all.

EMBER!

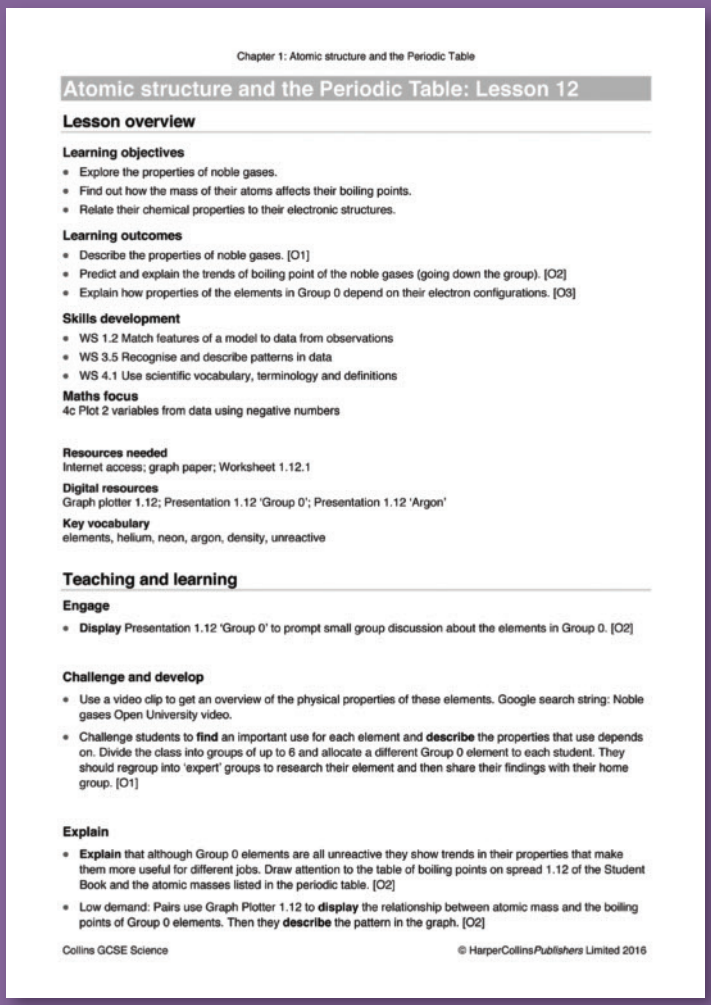
e the *power* to tell u how many places to ve the decimal point – aces to the left for large mbers, and places to the ht for small numbers.

Real-life contexts and applications are included to show students the relevance of the concepts they are studying

Higher-only content is clearly flagged for easy co-teaching

Teacher Packs

- Deliver the new GCSE Science curriculum with confidence, using the detailed support for introducing and teaching the new specification
- Make planning easy with 2, 3 and 5 year schemes of work and a comprehensive set of editable lesson plans and worksheets
- Equip students with the skills they need for working scientifically, using maths, and carrying out practicals
- Prepare students for the demands of the new specification with differentiated questions and activities in every lesson and targeted supporting worksheets
- Co-teach both Foundation and Higher tier with a single book (the Higher-only content is clearly flagged)
- All resources are also provided on CD-ROM



Chapter 1: Atomic structure and the Periodic Table

Atomic structure and the Periodic Table: Lesson 12

Lesson overview

Learning objectives
- Explore the properties of noble gases.
- Find out how the mass of their atoms affects their boiling points.
- Relate their chemical properties to their electronic structures.

Learning outcomes
- Describe the properties of noble gases. [O1]
- Predict and explain the trends of boiling point of the noble gases (going down the group). [O2]
- Explain how properties of the elements in Group 0 depend on their electron configurations. [O3]

Skills development
- WS 1.2 Match features of a model to data from observations
- WS 3.5 Recognise and describe patterns in data
- WS 4.1 Use scientific vocabulary, terminology and definitions

Maths focus
4c Plot 2 variables from data using negative numbers

Resources needed
Internet access; graph paper; Worksheet 1.12.1

Digital resources
Graph plotter 1.12; Presentation 1.12 'Group 0'; Presentation 1.12 'Argon'

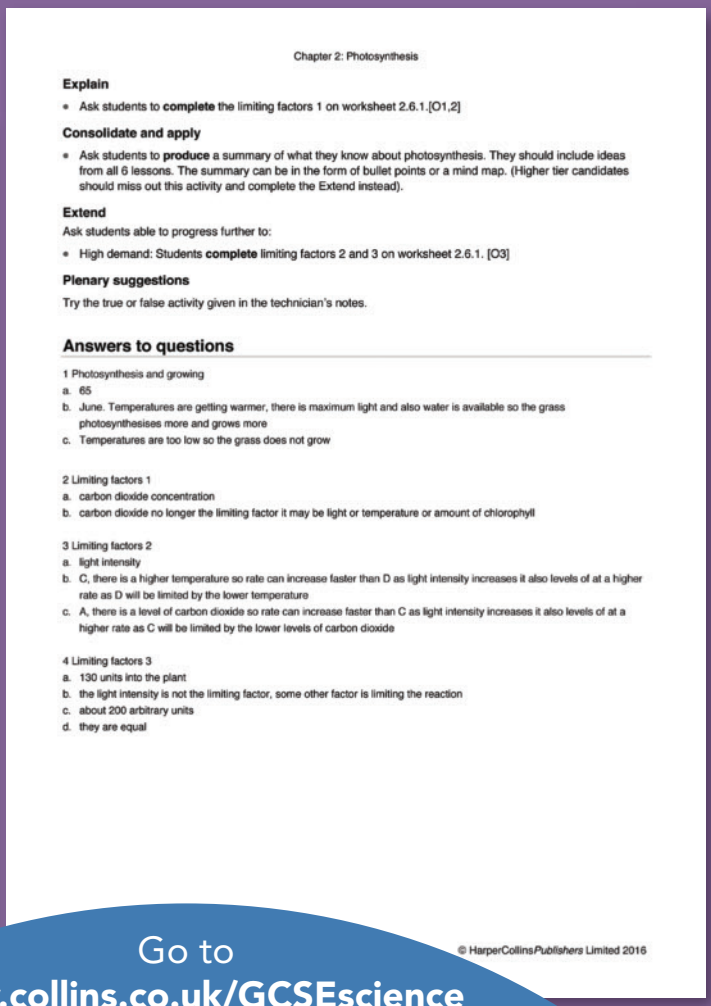
Key vocabulary
elements, helium, neon, argon, density, unreactive

Teaching and learning

Engage
- **Display** Presentation 1.12 'Group 0' to prompt small group discussion about the elements in Group 0. [O2]

Challenge and develop
- Use a video clip to get an overview of the physical properties of these elements. Google search string: Noble gases Open University video.
- Challenge students to **find** an important use for each element and **describe** the properties that use depends on. Divide the class into groups of up to 6 and allocate a different Group 0 element to each student. They should regroup into 'expert' groups to research their element and then share their findings with their home group. [O1]

Explain
- **Explain** that although Group 0 elements are all unreactive they show trends in their properties that make them more useful for different jobs. Draw attention to the table of boiling points on spread 1.12 of the Student Book and the atomic masses listed in the periodic table. [O2]
- Low demand: Pairs use Graph Plotter 1.12 to **display** the relationship between atomic mass and the boiling points of Group 0 elements. Then they **describe** the pattern in the graph. [O2]



Chapter 2: Photosynthesis

Explain
- Ask students to **complete** the limiting factors 1 on worksheet 2.6.1.[O1,2]

Consolidate and apply
- Ask students to **produce** a summary of what they know about photosynthesis. They should include ideas from all 6 lessons. The summary can be in the form of bullet points or a mind map. (Higher tier candidates should miss out this activity and complete the Extend instead).

Extend
Ask students able to progress further to:
- High demand: Students **complete** limiting factors 2 and 3 on worksheet 2.6.1. [O3]

Plenary suggestions
Try the true or false activity given in the technician's notes.

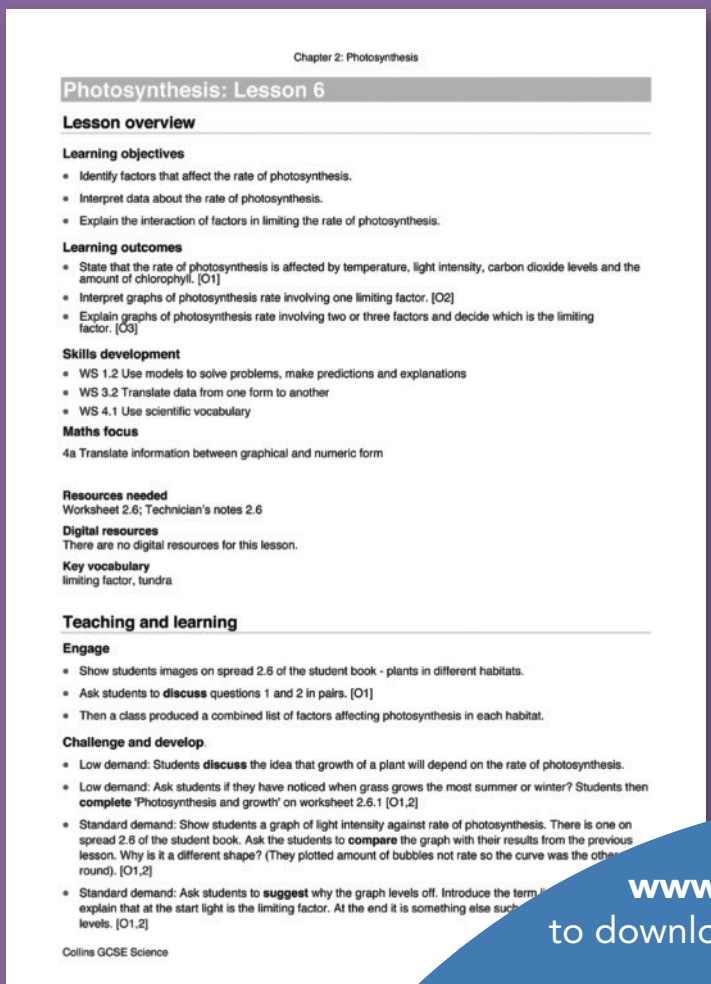
Answers to questions

1 Photosynthesis and growing
a. 65
b. June. Temperatures are getting warmer, there is maximum light and also water is available so the grass photosynthesises more and grows more
c. Temperatures are too low so the grass does not grow

2 Limiting factors 1
a. carbon dioxide concentration
b. carbon dioxide no longer the limiting factor it may be light or temperature or amount of chlorophyll

3 Limiting factors 2
a. light intensity
b. C, there is a higher temperature so rate can increase faster than D as light intensity increases it also levels of at a higher rate as D will be limited by the lower temperature
c. A, there is a level of carbon dioxide so rate can increase faster than C as light intensity increases it also levels of at a higher rate as C will be limited by the lower levels of carbon dioxide

4 Limiting factors 3
a. 130 units into the plant
b. the light intensity is not the limiting factor, some other factor is limiting the reaction
c. about 200 arbitrary units
d. they are equal



Chapter 2: Photosynthesis

Photosynthesis: Lesson 6

Lesson overview

Learning objectives
- Identify factors that affect the rate of photosynthesis.
- Interpret data about the rate of photosynthesis.
- Explain the interaction of factors in limiting the rate of photosynthesis.

Learning outcomes
- State that the rate of photosynthesis is affected by temperature, light intensity, carbon dioxide levels and the amount of chlorophyll. [O1]
- Interpret graphs of photosynthesis rate involving one limiting factor. [O2]
- Explain graphs of photosynthesis rate involving two or three factors and decide which is the limiting factor. [O3]

Skills development
- WS 1.2 Use models to solve problems, make predictions and explanations
- WS 3.2 Translate data from one form to another
- WS 4.1 Use scientific vocabulary

Maths focus
4a Translate information between graphical and numeric form

Resources needed
Worksheet 2.6; Technician's notes 2.6

Digital resources
There are no digital resources for this lesson.

Key vocabulary
limiting factor, tundra

Teaching and learning

Engage
- Show students images on spread 2.6 of the student book - plants in different habitats.
- Ask students to **discuss** questions 1 and 2 in pairs. [O1]
- Then a class produced a combined list of factors affecting photosynthesis in each habitat.

Challenge and develop
- Low demand: Students **discuss** the idea that growth of a plant will depend on the rate of photosynthesis.
- Low demand: Ask students if they have noticed when grass grows the most summer or winter? Students then **complete** 'Photosynthesis and growth' on worksheet 2.6.1 [O1,2]
- Standard demand: Show students a graph of light intensity against rate of photosynthesis. There is one on spread 2.6 of the student book. Ask the students to **compare** the graph with their results from the previous lesson. Why is it a different shape? (They plotted amount of bubbles not rate so the curve was the other round). [O1,2]
- Standard demand: Ask students to **suggest** why the graph levels off. Introduce the term l... explain that at the start light is the limiting factor. At the end it is something else such... levels. [O1,2]

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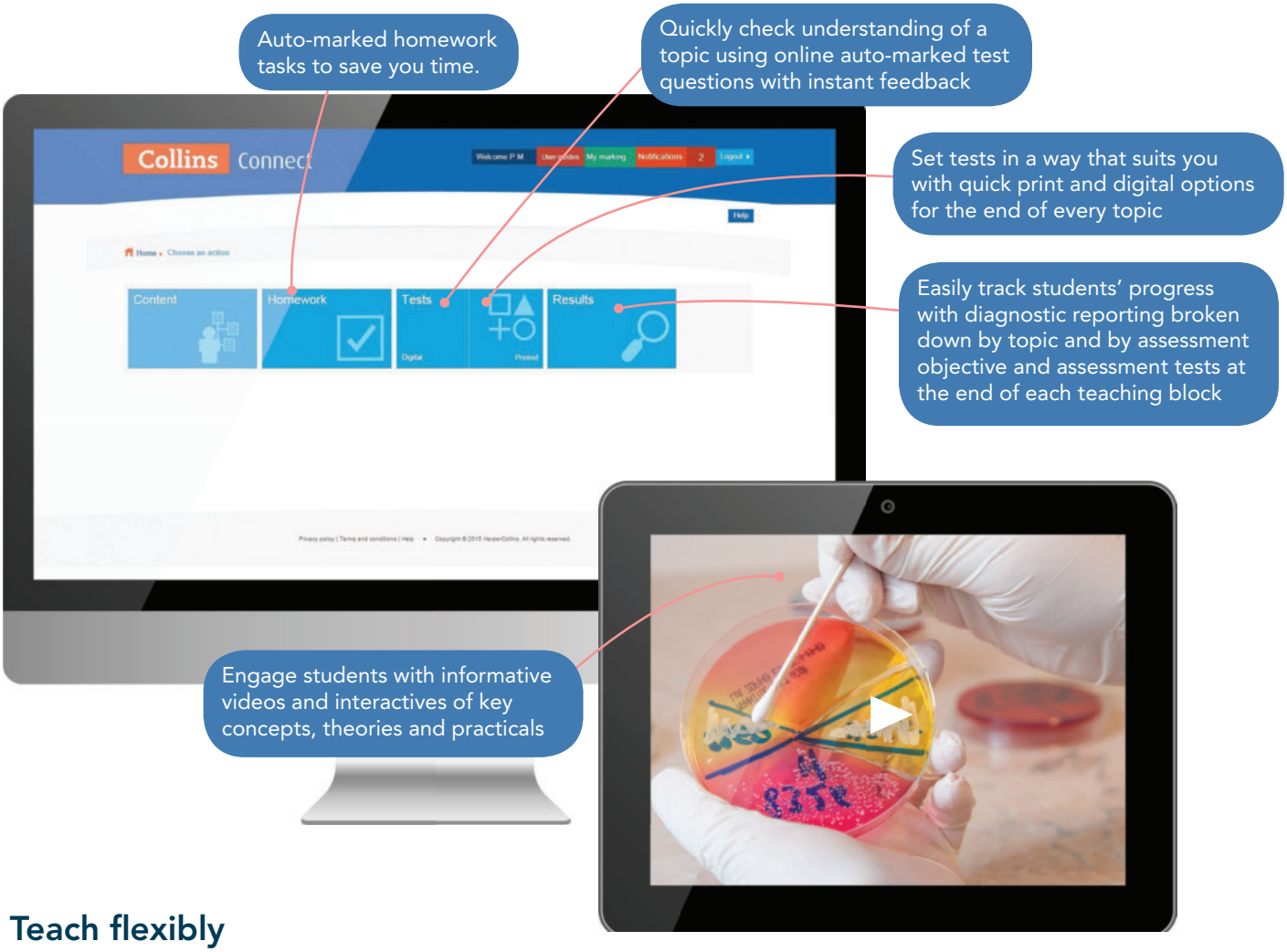

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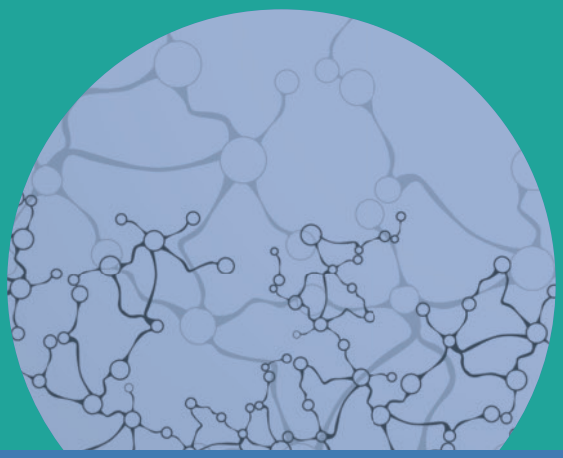

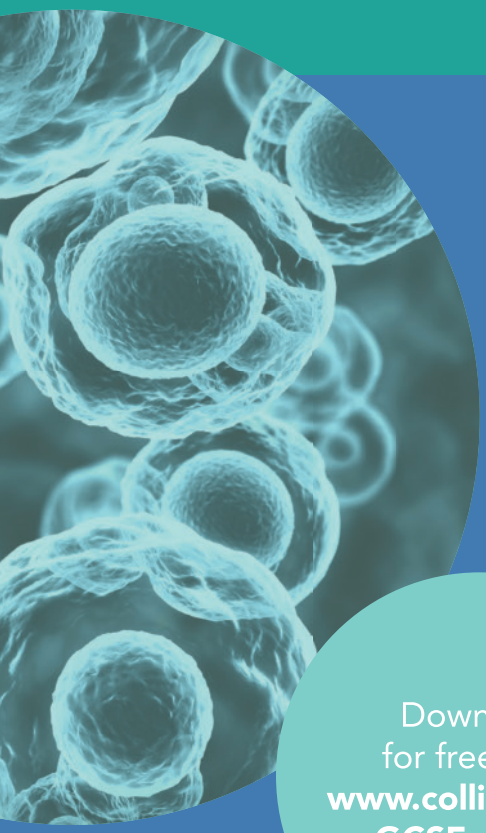

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About the Series Editor

Ed Walsh

Ed Walsh is a curriculum developer, CPD provider and school improvement officer. A teacher for twenty years and a team leader for twelve of those, he now writes and edits curriculum materials, designs and delivers CPD and works with science departments to improve the quality of their provision. He regularly presents sessions at ASE regional and national conferences and is a Regional Development Leader for the Science Learning Network in the south west. Ed's current projects include developing the Science Mark programme for the National Science Learning Centre, piloting the use of iPads in science teaching and writing STEM teaching materials for Siemens. He lives in Cornwall, where he works with local schools as Science Adviser.

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